, 16.26, 16.28, 16.33, 16.34, 16.35, 16.36

16.26 This problem combines the previous problem with the concept of an inclined plane. Just as the force of gravity is "deflected" by the use of an inclined plane, the air pressure on the fluid is also "deflected' by tilting the tube. Intuitively, it makes sense that the air chamber in the bottom will become longer, but by what factor? Either the sine of the angle or the cosine of the angle would be used, and since the air chamber increases, this could only happen mathematically if the initial length of the air chamber was <u>divided</u> by either the sine or the cosine.

• Consider the two extremes of tilting the tube: the tube is not tilted at all (the angle from vertical is zero), and the tube is tilted all the way to horizontal (the angle from vertical is 90°).

• Case 1 - Since the air chamber's length does not change at this angle, we must have divided by one to find the change in the air chamber length. Since the angle is zero and cosine of zero is 1, this is pretty good indication that solution is that we need to divide the initial length of the air chamber by the cosine of the angle (from vertical).

• Case two - If we were to lay the tube on its side, the liquid would simply flow out indefinitely, or to put it another way, the length of the air chamber would approach infinity. Since the angle is 90° and cosine of 90° is zero, dividing the initial air chamber by cos 90 shows that the length gets longer and longer (approaches infinity) as the angle approaches 90°. (Dividing by sine wold get the opposite effects).

The answer that the book gives seems mistaken and should read *"if the tube is now tilted so it makes and angle of 65° to <u>horizontal</u>..."*

That would make the angle from vertical equal to 25° and give an answer of 13.24 cm (13 to the proper number of sig figs)

16.28 <u>Gauge pressure</u> is equal to the <u>absolute pressure</u> inside the tank *minus* <u>atmospheric pressure.</u>

One way to remember this is to know that *absolute pressure is <u>absolutely the highest of the three pressures</u>*

Thus the absolute pressure inside the tank (which is what you need in PV=nRT) is equal to 630 kPa.

First you need to convert 5000 cm^3 to m^3

$$5000cm^3\left(\frac{1m}{100cm}\right)^3 = 5.0x10^{-3}m^3$$

noticed how I cubed the entire conversion factor. Be careful converting squared and cubed quantities.

You must also convert 25° C to ° Kelvin
Plug into PV=nRT

You should get *n* equal to 1.27 x 10^{-3} kmoles

16.33 Call Molar Mass, or the mass of one kilo-mole *M* and the mass of a sample of a gas *m*.

Thus, the number of moles of a gas *n*, is equal to $\frac{m}{M}$
and the ideal gas law can be written as

$$PV = \frac{m}{M}RT$$

This can be rearranged as

$$PM = \frac{m}{V}RT$$

but mass divided by volume is equal to density so we get

$$PM = (density)RT$$

You must convert the pressure to pascals from atms and then solve for the temperature.

16. 34 Read Dalton's Law of partial pressure on page 179

Convert 4.5 atm to cmHg (1 atm = 76 cm Hg).

Find what the pressure of the hydrogen gas is after it expands to 500.5 mL at constant temperature ($PV_{initial} = PV_{final}$)

Add to the pressure of the nitrogen

16.35 **THIS IS A VERY COMMONLY SEEN PROBLEM ON STANDARDIZED PHYSICS TESTS (BOTH AP AND IB)**

Treat the gases separately

Find what the pressure of the Helium will be as it expands from 450 cm^3 to 700 cm^3

Do the same thing for the Krypton as it expands form 250 to 700 cm^3

Add the pressures.

16.36 **THIS IS ALSO A CLASSIC STANDARD PROBLEM. (MY COLLEGE PHYSICS INSTRUCTOR GLEEFULLY CALLED IT "FARTING AT THE BOTTOM OF THE POOL PROBLEM.")**

First of all you need to know that the pressure at a depth *h* in a liquid is equal to

$$\rho g h$$

now the funny looking *p* is not a p at all but the Greek symbol "rho" and is the symbol for density.

The density of water is 1000 kg/m^3. Using this find the pressure at the bottom of the lake
Density in kg/m^3, g is 9.8m/s^2 , and h in meters gives pressure in pascals
(remember to add atmospheric pressure to this)

Then just use the combined gas law to find the new volume at the surface of the lake as a ratio of the old volume.